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...THE...

AMERICAN FERTILIZER

" That man is a benefactor to his race who makes two blades of grass to grow where but one grew before."

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Methods of Diagnosing Plant Nutrient Needs*

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WITHIN the last 10 years agronomists and soil chemists have given much attention to the development of rapid chemical soil test methods as a means of determining fertilizer practices. Numerous comparisons have been made of the different methods used in the various states. One of the outstanding facts resulting from such studies is that no method has yet been devised that is infallible. This has brought on some criticism and doubt about the advisability of using such tests.

The criticism arises out of the tendency of the operator to expect too much of the tests. It is not reasonable to think that these soil tests, in all cases, should correlate closely with the crop responses obtained from the use of fertilizers nor with the true status of the soil fertility. The reason for this lack of correlation is obvious when some of the peculiarities are considered.

Limitations of the Rapid Chemical Soil Test

Plant roots absorb elements out of the soil slowly but continuously for several months, while in soil tests the solvents are in contact with the soil materials for only a few minutes.

This would not matter so much in inorganic systems where chemical equilibrium is rapidly established, but in the dynamic, biotic soil complexes it is of utmost importance. Another consideration is that plant roots differ in their feeding properties; for example, sweet clover and alfalfa can obtain more phosphate in an alkaline soil that can corn or wheat. Soil tests, however, are usually designed for general crops and are not standardized for any praticular crop or kind of soil. It is to be remembered that soil tests have extracting solvents differing variously in pH and composition from those of the different plant roots; and the presence or absence of free carbonates greatly affects the acidity of the solvent. Moreover, plants feed out of the subsoil as well as out of the top soil; thus, soil samples usually do not represent the entire root environment. The plants absorb elements out of the whole soil complex, part of which may be alkaline (subsoil) and part acid (surface soil).

From this, it seems clear that the chemical soil test methods can not be used as more than an aid in determining the phosphate and potash supply. For determining the need for nitrogen, the soil tests are almost useless. The soil tests for acidity are most useful and can be considered invaluable as a guide to liming. Nevertheless, if the user of such tests recognizes these values and limitations, the rapid chemical tests can be and are invaluable aids in diagnosing the fertility situation in the soil with respect to the static levels of fertility and soil acidity.

Plant Tissue Tests as an Aid in Diagnosing

Many fertilizer experiments have been handicapped or have failed to give true information because experimenters assumed that the growing crop was adequately supplied with a particular nutrient element. This assumption was strengthened if the nutrient had been added to the soil as a fertilizer in amounts assumed to be adequate. However, the mere addition of the nutrient to the soil is no assurance that it is effectively entering the plant. Since it is only the nutrient that gets into the plant that is effective in feeding the crop, it is

*Presented before the Fertilizer Conference at Ohio State University October 30, 1942. Journal Paper No. 56 of the Purdue University Agricultural Experiment Station, Lafayette, Indiana.

most important to know whether or not the plant is absorbing this specific nutrient. The failure of the plant to obtain the nutrient may depend upon many factors such as: (a) too high placement of the fertilizer for the roots in drought periods, (b) movement of the nutrient to the surface out of reach of the roots, (c) leaching, (d) fixation, (e) poor root development or deficient aeration, and (f) toxic root zones.

Frequently fertilizer experiments conducted to determine the crop response to a particular nutrient element have resulted in no increase in yield even though it was reasonable to believe that the soil was deficient in this element. In such experiments, the effects of the other nutrient elements have presumably been eliminated by their addition as constants or by the thought that they were adequate in the soil. Since no response was obtained from the particular element being studied, the conclusion has unfortunately often been drawn that the element was not needed. It is in such instances that some information on the nutritional status inside of the growing plant becomes most helpful.

Purdue Plant Tissue Test Method

It is possible to determine, with the Purdue plant tissue test method, the nutritional status of a crop with respect to nitrate, inorganic phosphate, and potassium at any stage of growth. This technique has certain practical advantages and has served as a valuable diagnostic aid in evaluating the various soil treatments in the current fertilizer experiments in Indiana. Modifications in experimental work to eliminate some fundamental faults are being made as a result of information obtained with this procedure. The details of making the tests and the chemical solutions used are described in Purdue Bulletin 204 by Thornton, Connor, and Fraser.

From an extensive experience with the Purdue tissue test as a diagnostic aid, the author has found that the value of this test depends upon the common sense of the operator in making the logical interpretation of the results. He is compelled to abandon preconceived notions and must accept the facts presented by unalterable chemical reactions.

An Analogy to Describe the Tissue Tests

The use of an analogy may help to make clearer the concept the operator must have to interpret the results from the tissue tests.

If a machine in a factory is to operate at its full capacity, all the conveyors bringing in the raw materials must be running full. The supply of these materials in the stock-pile must be adequate to keep each conveyor filled. Whenever a particular conveyor starts to run partially empty, it means that the supply in the stock-pile of that material is low, and the production of the machine must slow down to the rate of the intake of the element present in the least amount. The slow-down in production is the first response to the scanty supply of any of the necessary raw materials, because the quality of the finished product must be upheld to a certain standard. However, if operations must proceed on a very deficient supply of a particular material, there is grave danger that the quality must also be sacrificed along with the reduced production.

A factory superintendent will keep an alert eye on the conveyors to see that they are always running full. He notes that when the rate of production slows down as a result of a scanty supply of material on one of the conveyors, the other raw materials tend to accumulate in unused forms on their conveyors in front of the machine. He is not fooled into thinking such a situation represents an over-supply of these materials in the stock-piles.

This analogy becomes a reality when certain words are substituted. The cells in the plant become the machine where the manufacturing takes place. The nitrates, phosphates, potassium, and other nutrient ions are the raw materials, and the conducting tissues (xylem tubes) become the conveyors.

In making a rapid chemical determination of the contents of the plant tissues with the Purdue plant tissue test method, the operator is, in fact, looking at the conveyors in the plant to observe if plenty of such essential nutrients as nitrates, inorganic phosphates, and potassium are entering the plant and passing on to the points needed. This test indicates the presence or absence of these nutrients in the conducting tissues of the plant in soluble, unassimilated form.

When the intent is to ascertain the first limiting nutrient growth factor, it seems important to differentiate between nutrients that have been assimilated, and the nutrients that are unassimilated and still in the role of a raw material.

The "assimilation" of potassium is not understood. A freshly cut plant that shows no potassium present by the tissue test method but contains potassium as shown by ash analysis may show a "high" test by the tissue test method after the plant is dried. Potassium will leach out of dreied hay, but not out

of the hay before it is dried. This indicates that the potassium is held by some form of adsorption in the living protoplasm.

It is for this reason the conveyor-tissue parts are cut instead of crushed or ground. The test does not show nutrients that have been assimilated into organic compounds. In this respect, the Purdue method differs markedly from tissue tests where the material is ground and emulsified, as in the Hestor method (Commercial Year Book 1941); or where analyses are made of the total contents of the nutrients in a part of the plant as in Thomas' and Mack foliar diagnosis method (Penn. Expt. Sta. Bul. 378); or where small amounts of ash are analyzed by the spectrographic method.

Plant Tissue Tests Have Different Objectives

It should be recognized that the Hestor plant tissue test is a relatively rapid laboratory test and has an important advantage in being quantitative. In the foliar diagnosis method of Thomas or in the spectrographic method, a quantitative laboratory analysis is involved. These methods are relatively long but invaluable in those kinds of research where precision is required. However, in the practical diagnosis of nutritional problems with growing crops, the semi-quantitative results obtained with the Purdue method are most helpful because of the rapidity and ease of making the tests. The large number of tests that can be made in a few minutes makes it an unpardonable laxity to guess at the nutritional status of the growing plant, when a large portion of the guess-work can be eliminated. If practical problems must rely on long precision methods for an answer, the common and natural procedure is to let the diagnosis pass with a guess and, more unfortunately, ignore the need for information on the nutritional status within the plant.

Diagnostic Point of View is Necessary

A person confronted with the problem of a poorly growing plant has somewhat the same problem as a medical doctor in a clinic when confronted with a patient. The diagnostician of plant difficulties must consider the optimum requirements of the plant as to temperature, moisture, freedom from insects or diseases, and nutrient supply. He must have an appreciation of the genetic potentialities of the plant, and must know when the plant is performing at its optimum, with respect to all external factors. A large crop of good quality should serve as the ultimate objective at which to aim.

Whenever a crop falls short of being as good as the best, the question arises,—What is the factor or factors holding back performance? Here the diagnostic procedure or common sense approach causes the diagnostician to examine all possible causes of trouble. How acid is the soil? Is it too acid for the crop or for legume bacteria? Is the acidity great enough to cause toxic amounts of soluble aluminum? Is the aeration so poor that it causes an anaerobic decomposition and the formation of toxic ferrous iron, or hydrogen sulfide, and /or the loss of nitrogen by dinitrification? Has the soil a cropping history of depletion, or have manure, crop residues, or fertilizers been used? If so, to what extent and kinds? How much corn, wheat, potatoes, soybeans, cotton, sugarbeets, etc., did the soil produce in past years? Do these yields reflect a high or low state of fertility? What are the characteristics of the soil? Is it low in organic matter so that nitrogen may be one of the first limiting factors? Is it a dark colored or muck-like soil so that K_2O may be the first limiting factor? The diagnostician may test the soil for so-called available nutrients. He recognizes the limitations of these tests, but they add information.

Then, if there is a crop growing, he looks for nutrient deficiency symptoms. These are another guide, but they are not always conclusive because nutrient situations may change within plants as they develop, or as the rainfall varies. He then goes a step further and analyzes the plants. A quantitative test of the tissue is desired in some instances, but in the practical diagnostic approach, the semi-quantitative test is adequate because the question is to find out if there is an abundance or absence of soluble nutrients present in the plant conveyors at the particular time of making the test.

The tissue test will indicate a nutrient deficiency before the leaves show the starvation symptoms.

Since the plant is a dynamic system growing out of the equally dynamic soil, where conditions of nutrition vary within the plant with the stage of growth, root development, and formation of the seed or fruiting body, and vary within the soil with moisture, fertilizer placement, aeration (oxidation and reduction), organic content (energy for micro-organisms,) temperature, and other factors, it is easy to see that variations in the nutrition of a plant as it grows are to be expected. This complexity of conditions has discouraged some from attempting to make tissue tests. Nevertheless, if the nutritional status within

the plant is determined frequently during its growing period, one gathers the information regarding the factors of nutrition which are limiting at any particular period.

It has been said, "Here is a field that shows low in nitrates in one plant, low in phosphate in another plant, and perhaps low in potash in still another; therefore, the tests are no good." In such a case the true situation is that the field is very deficient in all three nutrients, and the variations in tissue-test results are reflecting the true variation in the soil and in the plants. It must be realized that the tissue test indicates only what element is the first limiting nutrient growth factor at the time of the test.

A plant physiologist realizes that a plant is not uniform throughout its tissues in nitrates, phosphates, and potassium. Therefore, on what tissue should the test be made? A plant abundantly supplied with nutrients, so that more nutrients would not affect the plant growth, would show a "high" test in any of its tissues.

As the supply of nutrients falls off, the lower part of the plant will become deficient in phosphate and potassium before the growing tissues in the upper part of the plant are deficient. Such a plant may be producing a crop that is acceptable as to yields, but it is not going to yield as high as it would if the whole plant had a high test throughout the growing period in all its parts. This occurs without exception on fields of high-yielding corn.

As the supply of nitrates decreases, the upper part of the plants, where maximum utilization is in progress, will show a low test for nitrates first. Nitrates may show "high" in the base of the plant stalk after the upper plant part shows "low." Such a plant may be growing acceptably well and show no nitrogen-starvation symptoms, but may be lightly handicapped in its growth because of a slight shortage. If the base of the stalk shows no nitrates, the plant is starving seriously for nitrogen. The base of the stalk may show the presence of nitrates in the early morning but none later in the day when nitrogen metabolism has caused the plant to use the nitrates as fast as they enter. Such a plant needs more nitrogen.

These variations indicate that one needs to use some consideration of the changing situations involved when making the interpretations of the tests.

Investigators in soil-fertility research have not made as fast progress as possible because the point of view has not sufficiently included the "why of things" or the "how" and "why" of all the factors functioning in the performances of a growing crop. When the influences of all the potentialities within the sciences are to be considered in solving these crop problems, the investigator finds it necessary to do some systematic thinking and to follow a diagnostic procedure. This means that all known factors are examined and weighed before arriving at conclusions. Thus in studying the nutritional status of crops whether in experiments, fields, greenhouses, gardens, or in flower pots, one is constantly confronted with the problem of examining

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TABLE I

PLANT TISSUE TESTS AS AN AID IN THE STUDY OF LONG-TIME FERTILITY EXPERIMENTS WHERE VARIOUS PHOSPHATE CARRIERS ARE COMPARED. TESTS MADE ON CORN AT EARLY TASSELING STAGE. (HUNTINGTON, INDIANA; JULY 18, 1941. DATA BY M. T. VITTUM.)

Plot	Treatment*	Plant tissue tests: Nitrogen	Phosphorus	Potash	Average yield (Bu. per acre) 1919–1940	1941 Yield
1	None	High	Very Low	Very Low	36.1	26.8
3	BS	High	Low	Very Low	38.4	45.1
4	SP	High	Low	Very Low	37.6	49.3
5	RP	High	Low	Very Low	34.2	43.7
7	L+BS	High	Very Low	Very Low	39.1	45.1
8	L+SP	High	Very High	Very Low	39.3	36.6
9	L+RP	High	High	Very Low	37.5	35.2
20		High	Low	Very Low	44.8	54.9
21		High	Medium	Low	45.7	56.3

*BS = 200 No. of 18 per cent basic slag per acre on corn and wheat.
SP = 180 No. of 20 per cent superphosphate per acre on corn and wheat.
KP = 480 No. of 30 per cent rock phosphate per acre on corn and wheat.
L = 2 tons of ground limestone per acre applied in 1919.
Res. = Cornstalks and straw returned to the land.
PK = 300 No. of 0–12–4 per acre on corn and wheat.

Fertilizing Peaches for High Quality Fruit*

By DR. RICHARD V. LOTT

Department of Horticulture, University of Illinois

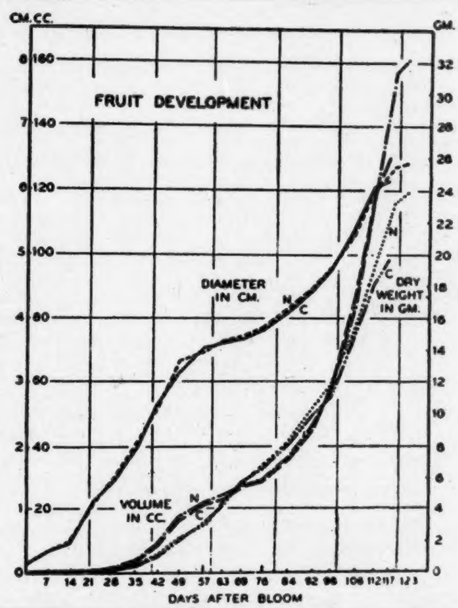
IN VIEW of the facts that the 1943 goal for fresh fruit is maximum production, that satisfactory prices are probable for peaches, and that a large percentage of the buds have been killed by low temperatures in some peach-producing regions, it is desirable for the peach grower to employ all possible means by which the production of high quality fruit may be increased.

The ultimate object of any fruit growing enterprise is the production of maximum crops of high quality fruit at minimum cost. The use of nitrogen fertilizer is an effective means of helping to attain this objective. Nitrogen increases production by affecting both tree growth and fruit growth. It increases the number and length of shoots, thus providing a greater bearing area and more fruit buds for the next year's crop. It also increases the number, size, and green color of leaves, thereby enhancing the food manufacturing potentialities of the leaves. Its use results in: a higher per cent of fruit set which is of considerable importance in years of heavy bud loss from low temperatures; usually less extensive fruit drops; larger-sized fruit when trees are properly thinned; no significant difference in quality when the amount applied is not excessive.

The above results can be expected unless the supply of other plant nutrients is limited, as has been reported in South Carolina, for example. The use of excessive amounts of nitrogen over a term of years may result in extreme vegetative growth and fruit of inferior quality. This condition can be avoided easily by limiting the amount applied to that which results in a large number of well-distributed shoots 10 to 18 inches long and relatively few shoots two to three feet or more in length.

In Table I and Fig. 1 are shown some results from a study at Urbana, Illinois, in 1938 of the development of fruits from unfertilized and nitrogen fertilized 6-year-old Halehaven trees of moderate vigor. The fertilized trees were given two applications of nitrate of soda or five pounds each; the first, 17 days before full bloom and the second, just as the stones were beginning to harden, which was 51 days after full bloom. This unusally large amount was applied to insure a difference in vigor.

Fig. 1 shows that the fruit increase in size (diameter and volume) in three periods: the first period ending approximately 57 days after bloom when the stone was first considered to be hard; the second of slower size-increase ending approximately 76 days after bloom; and the third period of rapid size-increase until harvest. However, on the dry weight basis there was no second period of fruit growth. Since dry matter accumulation expresses development on a nutritional basis, the grower should keep in mind the fact that, even though there is a period of slow increase in fruit size, the nutritional needs, including nitrogen, are increasing during this period.



Fig, 1 also shows that the significant effect of nitrogen on both size and dry weight occurred near harvest, as is evident by the con-

* Reprinted from *American Fruit Grower*, June, 1943.

tinued development of the nitrated fruit after the check fruits had begun to ripen. This caused the nitrated fruits to ripen six days later than the check fruits. Both lots of fruit were harvested at approximately three pounds pressure with the Blake pressure tester, using the 3/16" plunger. Growers should be especially careful to allow fruit on nitrated trees to reach maximum handling maturity in order to get the full benefit of the effect of nitrogen on fruit size and to allow maximum sugar development.

Table I is limited to the third period because Fig. 1 shows that the effects of nitrogen did not become apparent until that time and particularly near harvest. The check fruits were 3.7 times as large at harvest as at the beginning of this period and the nitrated fruits were 4.5 times as large. This shows the need for orchard practices which provide an extensive and healthful leaf area for carbohydrate manufacture. The fact that the large size increase in the third period occurred in only 33 days in the check fruits and 39 days in the nitrated fruits, whereas the previous growth of the fruit had occupied 84 days, further emphasizes the very rapid growth that occurred during this period and also shows the need for nitrogen applications early enough in the season to provide the extensive leaf area needed at this time if maximum size is to be obtained.

TABLE I

INCREASE IN FRUIT VOLUME AND IN SUGAR CONTENT OF PEACH FLESH DURING THE THIRD GROWTH PERIOD. HALEHAVEN, URBANA, ILLINOIS, 1938. C = FRUIT FROM CHECK TREE. N = FRUIT FROM NITROGEN FERTILIZED TREE.

Growth period	Date collected	Days after bloom	Volume in cc. C	Volume in cc. N	Per cent sugar* C	Per cent sugar* N
III	July 7	84	35.12	35.32	4.59	4.54
	July 15	92	44.80	45.00	4.31	4.28
	July 21	98	58.00	57.64	4.78	4.70
	July 29	106	87.00	83.80	5.58	5.30
	Aug. 4	112	118.20	118.00	6.03	6.11
	Aug. 9	117	130.68	——	7.95	——
	Aug. 11	119	—	157.00	—	7.21
	Aug. 15	123	—	160.28	—	7.87

*Per cent of fresh weight.

Table I shows that the sugar content of the flesh of both lots of fruit was 73 per cent greater at harvest than at the beginning of the period, even though the number of days concerned was less than half that of the first and second periods. Here again the importance of nitrogen in developing an extensive leaf area is apparent for not only was the sugar content of the nitrated fruits approximately the same as that of the check fruits, but also the nitrated fruits were 22 per cent larger, even though there were more fruits per tree.

The increases in size and sugar content shown in Table I emphasize the desirability of allowing the fruit to become as mature as is consistent with the operations necessary in harvesting and packing. The check fruits on July 29 were in the stage of maturity at which peaches are commonly harvested commercially. From July 29 to August 4 the size of the fruit increased 35 per cent and the sugar content eight per cent. From July 29 to August 9, the size increased 50 per cent and the sugar content of the flesh 42 per cent. The calculations for the same maturity stages in the nitrated fruits show that in the seven days from August 4 to 11 the size of the fruit increased 33 per cent and the sugar content 18 per cent, and in the eleven-day interval, August 4 to 15, the size increased 35 per cent and the sugar content of the flesh 28 per cent.

Furthermore, careful observation shows that the flavoring compounds of the peach increase very rapidly during this time. These data show that employing extra care in picking, transporting, handling, and packing so that fruit can be harvested in as mature a condition as possible will provide significant increases in yield and quality and probably in market price.

The discussion above on the increases in sugar content and flavoring compounds of the flesh shows why the consumer can be expected to prefer more mature peaches. Furthermore, the percentage of the fruit was flesh-increased as the fruit neared maturity, which means that there is less waste from stones and peel as the fruit matures. The nitrated fruit had a slightly higher per cent of flesh than the check fruits and no detectable difference in quality by disinterested observers. Therefore, the desirable qualities of the fruit can be maintained in fruit from nitrogen fertilized trees and the yield significantly increased at the same time because of greater set and increased fruit size as compared to unfertilized trees.

In view of the facts presented above, the following recommendations are made for 1943. If a nitrogen application was not made preceding or at bloom, apply either nitrate of soda or sulfate of ammonia at any time up to the early part of the third period of size increase. It will be of some help in increasing fruit size and will be an advantage in the gen-

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Superphosphate Producers Urged to Increase Production

On May 17th, Dale C. Kieffer, Chief of the Fertilizer Materials Unit of WPB, wrote to each manufacturer of superphosphate, asking for estimates of that plant's production for the 1943–44 fertilizer year. He emphasized the need for about 6½ million tons of normal superphosphate (basis 18 per cent) and in each letter suggested a goal for that particular company to shoot at. Also stressed was the need for regular shipments to mixers and to farmers throughout the year in order to take advantage of the increased supply of ammonia liquors expected for the coming year.

The text of the letter is as follows:

GENTLEMEN:

In order to meet the wartime requirements for food, feed and fiber, it is anticipated that American agriculture will call upon the fertilizer industry to produce in 1943–1944 an unprecedented quantity of fertilizers. Like agriculture, the fertilizer industry will be facing the problem of increased production with limited labor and equipment, but it is believed that with careful planning the supply of fertilizers will not be a limiting factor in the food production program.

Approximately 6,500,000 tons of normal superphosphate must be produced during the 1943-1944 year to round out the fertilizer program. It is realized that this production will require the full cooperation of each superphosphate producer. The Chemicals Division of the War Production Board has assured the War Food Administration that producers will cooperate and that every effort will be made to meet this requirement. The 6,500,000 tons of ordinary superphosphate includes 5,000,000 tons for distribution through commercial channels and 1,500,000 tons for the Agricultural Adjustment Agency Program. In order to insure that this requirement will be met, a tentative quota has been established for each active superphosphate plant in the United States. This quota is based largely upon monthly production records since September 1942.

A suggested goal for your company is .... tons of normal superphosphate (basis 18 per cent), in equal monthly quantities if possible. If after careful consideration of all factors involved you believe that it will not be possible to produce this quantity, it will be appreciated if you will promptly inform this office. We will render whatever assistance we can in overcoming production obstacles. If a production greater than the above figure can be realized, please inform us as to the quantity. This quota is not intended as an upper limit on your production, but as a minimum target figure.

In order for each plant to reach maximum production, it is obviously necessary to operate throughout the year, moving the superphosphate to mixing plants and to the farmers almost as fast as it is produced and cured. Fertilizer mixers will be urged to cooperate by accepting delivery of superphosphate in equal monthly installments and farmers by purchasing much of their fertilizer requirements prior to the season of application. Only in this way can we fully utilize available storage facilities and take advantage of the supply of ammonia liquors which are expected over the next twelve months.

If the superphosphate industry tackles the 1943–1944 program with the same wholehearted coooeration which it has exhibited during the 1942–1943 season, it is believed that the 6,500,000 tons of superphosphate can and will be produced.

Very truly yours,

DALE C. KIEFFER,
Chief, Fertilizer Materials Unit.

April Sulphate of Ammonia Production

The production of by-product sulphate of ammonia continues at the levels established for more than a year, namely, about 2,000 tons per day. During the month of April, production totaled 63,840 tons, a decrease of 3 per cent from the month of March, which contained one more production day. Shipments during April were slightly less than production, with the result that stocks on hand at the end of the month showed a light increase. The figures reported by the U. S. Bureau of Mines are as follows:

	SULPHATE OF AMMONIA	AMMONIA LIQUOR
Production	*Tons*	*Tons NH_3*
April, 1943	63,840	2,872
March, 1943	65,794	2,868
April, 1942	63,765	2,818
January–April, 1943	252,881	11,233
January–April, 1942	253,122	11,208
Shipments		
April, 1943	63,351	3,066
March, 1943	74,949	3,264
April, 1942	70,153	3,146
Stocks on Hand		
April 30, 1943	23,585	728
March 31, 1943	23,325	801
April 30, 1942	8,792	662
March 31, 1942	15,574	745

Cottonseed Meal Production Increased

During the first nine months of the crop year (from August 1, 1942 to April 30, 1943) the amount of cottonseed crushed at the mills in this country totaled 4,197,567 tons, an increase of about 10 per cent over the same period of the preceding year. Cake and meal produced came to 1,856,701 tons, compared with 1,621,027 tons in the same period of 1941–42. Shipments of meal, however, have increased greatly, and as a result the amount on hand at the mills on April 30, 1943 was only 37,431 tons, a serious drop from stocks of 312,038 tons on the same date in 1942.

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Principal Articles in This Issue

Chemical Nitrogen Permitted for Fall-sown Grains

Because of improved chemical nitrogen supplies, coupled with the need to increase production of livestock feed, the War Food Administration has announced that the use of chemical nitrogen will be permitted on 1943 fall-sown grains for harvest.

Use of chemical nitrogen on such crops was prohibited in 1942 when the supply situation indicated the need for extensive conservation measures in the use of this material. Unprecedented demand on the available supply, including heavy military requirements, made it necessary to confine agricultural uses of chemical nitrogen to only the most essential war food crops, and to those whose successful production depends on sufficient application of this fertilizer material. Consequently, its use on fall-sown grains for harvest was prohibited in line with conservation measures.

It is estimated by WFA officials in charge of fertilizer supply programs that the quantity of chemical nitrogen which will be available to agriculture during the fertilizer year beginning July 1, 1943, will be about 15 per cent larger than the record amount used by the Nation's farmers in 1941. It is expected that farmers will obtain most of their requirements for essential 1943 food and feed crop.

WFA officials, commenting on the action liberalizing the uses of chemical nitrogen, stated that the supply situation has improved principaly because of greater domestic production and an easing up of military requirements. With an improved supply on one hand, and the need for greater production of livestock feed on the other, the action was taken to make chemical nitrogen available for use on 1943 fall-sown grains. The measure is designed to give farmers in the areas concerned all possible assistance in increasing their feed production in support of the Nation's expaned wartime livestock production program.

The action permitting use of chemical nitrogen on fall-sown grains will affect chiefly the Eastern soft red winter wheat producing area, particularly Indiana, Ohio, and Pennsylvania, where use of chemical nitrogen for this purpose is heaviest, and several Southern States. Provision of nitrogen for this purpose will be included in an order, to be issued at an early date, which will cover the uses of fertilizers during the new fertilizer year.

Farmers may apply to their regular dealers for the fertilizer in quantities to cover their usual rate of application on the acreage they expect to plant.

Deliveries of Potash Salts During First Quarter 1943

The American Potash Institute, Inc., announces that deliveries of potash salts within the continental United States, Canada, Cuba, Puerto Rico and Hawaii by the four major producing companies during the first quarter of the calendar year 1943 amounted to 346,254 short tons of salts, equivalent to 178,883 tons of actual K_2O. Constituting this total were 317,033 tons of salts, equivalent to 160,830 tons K_2O, designed for agricultural use, made up of 228,051 tons of muriate, 61,137 tons of manure salts, and 27,845 tons of sulfates. For chemical use deliveries amounted to 29,221 tons of salts, equivalent to 18,053 tons of K_2O. These figures include salts of domestic origin only.

Compared with the first quarter of 1942, these deliveries represent an increase of 26,581 tons of potash salts, equivalent to 14,000 tons K_2O, from the total of 319,673 tons of salts, equivalent to 164,877 tons K_2O, delivered during the corresponding period of a year ago, an increase of 8 per cent, principally in the category of agriculuralsalts.

For the twelve-month period, April 1, 1942 to March 31, 1943, total deliveries of potash salts amounted to 1,279,709 tons, equivalent to 674,161 tons K_2O, a 19 per cent increase in salts and a 20 per cent increase in K_2O equivalent over deliveries of the preceding twelve-month period.

POTASH DELIVERIES

Short Tons K_2O

(United States, Canada, Cuba, Puerto Rico, Hawaii)

	Jan.-March 1943	Jan.-March 1942
Muriate	134,251	120,288
Manure Salts	15,284	14,519
Sulfate and Sul. Pot. Mag	11,295	13,690
Total Agricultural	160,830	148,497
Chemical Potash	18,053	16,380
GRAND TOTAL	178,883	164,877

Barrett Offers New Nitrogen Fertilizer

The Barrett Division of the Allied Chemical & Dye Corporation has placed on sale a new nitrogen product, "A-N-L" brand of fertilizer compound, manufactured at Hopewell, Va. The product is guaranteed 20.5 per cent nitrogen and analyses as follows:

	PER CENT
Nitrate nitrogen	10.25
Ammonia nitrogen	10.25
Calcium oxide	9.00
Magnesium oxide	7.00

The price for shipment during the month of May, subject to change without notice, is $32.50 per net ton in 100-pound bags, f.o.b. Hopewell. At the present time, WPB is allocating this material only for top dressing purposes.

Anaconda Sales Office to Move to Anaconda, Montana

Effective July 1, 1943, all business of the Anaconda Sales Company, Fertilizer Department, will be conducted under the name of the Anaconda Copper Mining Company, Fertilizer Department, Anaconda, Montana.

Mr. R. A. Jones has been appointed Sales Manager of the Anaconda Copper Mining Company, Fertilizer Department, with offices at Anaconda, Montana.

All correspondence concerning fertilizer matters will be addressed to the Anaconda Copper Mining Company, Fertilizer Department, Anaconda, Montana.

Sales of Fertilizers for Tests Permitted

Food Production Order No. 5 has been amended so as to remove restrictions on the sales of chemical fertilizers for test purposes, effective May 27th. The wording of the amendment of paragraph (C) (3) is as follows:

(3) The restrictions provided for in this order shall not apply to:

(i) Deliveries of chemical fertilizer for experimental purposes to educational institutions or publicly owned agricultural institutions, or to the use of chemical fertilizer by such institutions for such purposes.

(ii) Deliveries of chemical fertilizer by the Tennessee Valley Authority for use on farms selected as experimental test demonstration farms, or to the use by any person on such farms of chemical fertilizer so delivered.

May Tax Tag Sales

Fertilizer tax tag sales in the 17 reporting States in May amounted to 447,873 tons. This represented increases of 36 per cent over May, 1942, and 35 per cent over May, 1941.

Sales in all States in the southern region in the January-May period were larger this year than last. Sales in the Midwest were practically the same this year as last, with increases in three States offset by declines in the other two.

Total sales in the first five months of this year amounted to 5,262,993 tons, a 12 per cent increase over the corresponding period of 1942. January-May sales in the 17 tag sale States in past years have accounted for more than half of total annual fertilizer consumption in the United States. It seems likely in view of the 582,000 ton increase in tag sales this year over last, fertilizer consumption for 1943 will set a new record.

Ammonia Nitrate Being Shipped from Muscle Shoals

Shipments of ammonia nitrate are being made from the plant of the Tennessee Valley Authority in Muscle Shoals, Ala. The new ammonia nitrate will go to Kentucky, Virginia, North Carolina, South Carolina, Georgia, Alabama, Tennessee, Mississippi, Louisiana, Texas, Arkansas, Wisconsin and New York.

FERTILIZER TAX TAG SALES

State	May 1943	May 1942 Tons	May 1941 Tons	% '42	January–May 1943 Tons	January–May 1942 Tons	January–May 1931 Tons
Virginia	36,459	25,491	28,848	102	310,183	305,482	289,167
N. Carolina	83,651	47,720	52,400	107	1,062,646	996,122	967,275
S. Carolina	37,143	28,890	39,194	118	683,038	577,234	643,957
Georgia	40,067	31,440	11,500	119	844,781	707,212	734,872
Florida	66,248	68,329	53,654	112	374,618	335,272	305,545
Alabama	41,700	23,950	28,000	114	610,500	537,150	554,950
Mississippi	33,431	19,925	11,005	121	325,167	269,390	305,042
Tennessee	26,183	16,460	11,608	131	180,222	137,770	119,271
Arkansas	4,570	10,150	7,050	112	140,055	125,550	111,250
Louisiana	5,075	8,500	5,350	110	142,138	128,786	145,580
Texas	12,380	6,355	8,855	118	125,610	106,088	115,947
Oklahoma	339	415	118	204	14,910	7,311	8,755
TOTAL SOUTH	387,246	287,625	257,582	114	4,813,868	4,233,367	4,301,611
Indiana	33,675	16,062	40,233	98	230,800	236,503	200,542
Illinois	11,680	6,644	16,148	105	65,414	62,273	46,476
Kentucky	14,200	19,325	16,847	93	106,203	114,571	93,634
Missouri	1,072	281	752	132	43,418	32,934	36,283
Kansas	0	5	135	260	3,290	1,264	5,568
TOTAL MIDWEST	60,627	42,317	74,115	100	449,125	447,545	382,503
GRAND TOTAL	447,873	329,942	331,697	112	5,262,993	4,680,912	4,684,114

FERTILIZER MATERIALS MARKET

NEW YORK

Reduction in Freight Rates Will Benefit Fertilizer Manufacturers. Potash Contracts Made and Waiting Approval. Shipments Continue. Little Optimism for Prospective Production of Fish Meal. Superphosphate Deliveries Still at Maximum.

Exclusive Correspondence to "The American Fertilizer"

NEW YORK, June 1, 1943.

The 6 per cent reduction in freight rates as of May 15th will mean a considerable saving to fertilizer manufacturers as many of the fertilizer materials, such as nitrogenous, potash and, in many cases, superphosphates, are purchased on an f.o.b. basis. However, this difference in freight becomes so infinitesimal when farm products are purchased by the ultimate consumer that we cannot see how any effect will be felt by such ultimate consumer.

Sulphate of Ammonia

New allocation orders are being awaited and probably such new allocations will be issued shortly for the new season.

Nitrate of Soda

The June price will remain the same and demand continues both for military and agricultural needs, all deliveries being made against allocation only.

Potash

Contracts are now being made but no approvals have yet been issued by Washington for the second period. However, sellers are privileged to ship a certain proportion of last year's tonnage sold and most manufacturers will continue their shipments of potash without any stoppage. Due to the floods there have been some difficulties in delivering potash to certain areas.

Fish Meal

It is expected that the fishing season will start shortly but there is not much optimism felt as to the prospective catch on the eastern shore.

Superphosphate

There has been no change in this situation with buyers continuing to accept all material available. There have been no deliveries of triple superphosphate to domestic buyers, with the probability that none of this material will be available for domestic use during the month of June. There has been no definite decision as yet as to what may be available for domestic buyers from July 1st forward.

BALTIMORE

Spring Tonnage Restricted Only by Labor Shortage. Ammonium Nitrate Shipments Ease Sulphate Situation. Adequate Potash Production Expected.

Exclusive Correspondence to "The American Fertilizer"

BALTIMORE, June 1, 1943.

The spring shipping season is still on but with the advent of more seasonably warm weather will probably have tendency to bring it to an early conclusion. Were it not for the shortage of labor, the tonnage would probably be in excess of last year.

Ammoniates.—Organic ammoniates for fertilizer are off the market, due to the higher ceiling prices prevailing on organics for feeding purposes.

Nitrogenous Material.—There is nothing offering in the way of either nitrogenous or vegetable meals.

Sulphate of Ammonia.—Shipments of ammonium nitrate by the Tennessee Valley Authorities to fourteen States is expected to have an easing tendency on the ammonium sulphate situation in the other consuming States. Up to the present time, however, no new allocation of tonnage has been made, although expected momentarily.

Nitrate of Soda.—Domestic production during June will be at same prices as prevailed during May and tonnages also under allocation.

Potash.—Contracts are now being booked by domestic manufacturers, and it is anticipated

that the production again will be sufficient for legitimate manufacturing requirements of America fertilizer producers.

Superphosphate.—No change in the situation, and no heavy stocks of superphosphate are accumulating. Ceiling price of 64 cents per unit for run of pile, in bulk continues without change.

Bone Meal.—The market is practically bare of all grades, and, in consequence of this, prices are strictly nominal.

Bags.—Nothing new in the situation as far as burlap bags for fertilizer are concerned. In the meanwhile large percentage of shipments during the past season were made in paper bags and this condition will doubtless prevail for the duration.

CHARLESTON

Stocks of Organics Frozen by Government. Requests for Imports of Dried Blood Considered. No Changes in Price Ceilings.

Exclusive Correspondence to "The American Fertilizer"

CHARLESTON, June 1, 1943.

All stocks of organics have been frozen by the Government effective June 1st, and no definite information under FPO No. 12, has yet come out. Some producers think that the information will be available in the next couple of weeks.

Dried Blood.—Appeals to Washington are being considered for the importation of this material from South America. However, with the shortage of feeding materials, possibly the largest part, if any importation is authorized, will go into feed. Domestic material is priced at $5.38 per unit of ammonia, ($6.54 per cent N) f.o.b., Chicago.

Sulphate of Ammonia.—The manufacturers are awaiting the new allocation order but no information has come out on this yet.

Nitrate Soda.—The price of the domestic material for June shipment has been announced the same as that prevailing in May.

Cottonseed Meal.—Supplies are negligible, and nominal quotation for the 8 per cent grade in Atlanta is $38.60.

Soybean Meal.—The supply is short and Atlanta quotations are around $45.75.

PHILADELPHIA

Shipments Proceeding at Faster Rate. Difficulties Expected in Administering the Allocation of Organic Nitrogen.

Exclusive Correspondence to "The American Fertilizer"

PHILADELPHIA, June 1, 1943.

Now that the weather has become a little more "seasonable" in this section, the mixers are concentrating on shipping out their mixed goods. It appears as though some mixers are a little behind in their shipments, owing to the demand all at once, and the transportation difficulties. The demand, however, for all raw materials continues.

Ammoniates.—The WFA order covering nitrogenous materials apparently still needs clarification, although it has been reported somewhere that the order may be rescinded, due to the complexity of the number of items and the entailing difficulty in administration of the order. It has been claimed that the amount of work involved in trying to administer this order would exceed the value derived from it. The tonnage of nitrogenous materials is small compared to the chemical nitrogen production and consumption, and it would be difficult to arrange any kind of equitable distribution of organics.

Sulphate of Ammonia.—Trade is awaiting the latest allocation order for this material.

Nitrate of Soda.—One producer of this item has announced prices for June, which are the same as applied for May.

Superphosphate.—Prices, of course, are at ceiling levels, and the demand continues good, although it appears that production is sufficient to take care of that demand.

Bone Meal.—Apparently there is no let-up in the demand for bone meal, and supplies appear to contine at a low point.

Potash.—Production still seems to be holding at a good rate, and likewise demand continues high.

TENNESSEE PHOSPHATE

May Rains Hinder Farm Work. Rock Mining Keeping Abreast of Shipping Requirements. New Operations Reported.

Exclusive Correspondence to "The American Fertilizer"

COLUMBIA, TENN., June 1, 1943.

May 1943 has brought the heaviest precipitation for years and while this section has been free from the disastrous floods of the middle corn belt region, much work has gotten very considerably behind. Some corn is not yet planted and much tobacco not yet set out, but work in the mines has kept up fairly well. The mining end has been able to keep up with the shipping end by reason of shortage of car supply for a week or two, due to combination of flood troubles and extra call for equipment to handle the enormous early fruit and berry crop. Likewise many farmer users of ground phosphate rock for direct application have been forced to postpone or cancel shipments due, because of floods and wet weather. Some sections of the phosphate using area have not yet been able to harvest the 1942 crop of soy beans and even some corn.

It is reported that the small operators on Swan Creek in Hickman County, have purchased a Williams Mill and expect to be operating during the present year. Rumor also has it that the Federal Chemical Co., at Mt. Pleasant, at whose plant the first rock was ground for direct application in 1897, and who again operated and discontinued in the direct application line in 1913 and 1914, are again considering installing mills at Ridley for this purpose.

CHICAGO

Little Action in Fertilizer Organics Market. Details of FPO No. 12 Awaited. Imports of South American Feed Materials Proposed.

Exclusive Correspondence to "The American Fertilizer"

CHICAGO, June 1, 1943.

The organic market during the interim has been as devoid of action as that of any previous report. Trade is awaiting the definite instruction relative to FPo No. 12, particularly as to the question of allotments. Meanwhile no offerings are being made by sellers.

Considerable interest is being expressed by the proposed importation of South American tankage and blood, but no announcement has been made of charters. If this material is shipped, it will be entirely used for feed purposes.

No change in ceiling prices: High grade ground fertilizer tankage, $3.85 to $4.00 ($4.68 to $4.86 per unit N) and 10 cents; standard grades crushed feeding tankage, $5.53 per unit ammonia ($6.72 per unit N;) blood, $5.38 ($6.54 per unit N); dry rendered tankage, $1.21 per unit of protein, Chicago basis.

Millions Saved in Reduced Freight Rates

OPA estimates that more than $350,000,000 will be saved on an annual basis by American consumers, including the Government, and by producers, processors, and distributors as a result of a reduction in railroad freight rates that went into effect May 15. The reduction was ordered by I.C.C. following a petition from OPA on the ground that further collection of increases granted early in 1942 was unnecessary and inflationary in effect. In most cases, OPA says, the savings will be reflected automatically in reduced prices through the operation of existing maximum price regulations. In some instances where reductions will not be automatic, amendments

are being issued to insure that the freight savings are passed on to consumers. In some instances the saving in freight is being left at the producer or processor level to ease squeezes between the cost of raw materials and ceilings imposed at those levels so that the line may be held at the consumer level. In the field of food generally, including products of agriculture used for industrial purposes, and also including fertilizers, the saving due to the freight reduction at all levels is estimated to be upward of $42,000,000.

Organic Nitrogen Order Revised

Effective June 1, 1943, the War Food Administration has issued a revision of Food Production Order No. 12. Under this revision a processor or producer of organic nitrogenous material may make delivery thereof, for fertilizer purposes, only to a person authorized to acquire such material and for specified purposes, as follows:

(1) During the period June 1, 1943, to June 30, 1944, each fertilizer manufacturer is authorized to acquire organic nitrogenous material for use at each fertilizer mixing plant operated by such manufacturer in the manufacture of mixed fertilizers for sale, but the quantity of such material acquired for such purpose shall not exceed, on a nitrogen unit basis, 70 per cent of the total quantity used at such plant for such purpose during the period July 1, 1941, to June 30, 1942, taking into account, however, the quantity of such material in mixed fertilizers on hand on June 1, 1943, and the quantity of such unmixed material on hand on such date which may be used in the manufacture of mixed fertilizers for sale.

(2) During the period June 1, 1943, to June 30, 1944, each fertilizer manufacturer is authorized to acquire organic nitrogenous material for sale at each fertilizer mixing plant operated by such manufacturer to consumers for use in home mixing, but the quantity of such material acquired for such purpose shall not exceed, on a nitrogen unit basis, 70 per cent of the quantity sold from such plant to consumers for use in home mixing during the period July 1, 1941, to June 30, 1942, taking into account, however, the quantity of such material on hand on June 1, 1943, which may be sold for use in home mixing.

No fertilizer manufacturer shall use or deliver any organic nitrogenous material acquired as above, for any other purpose than those specified.

Provision is made for approved specialty fertilizers and for sales to the armed forces and to experimental users.

Sales under paragraphs 1 and 2 above are on a plant basis, not on a company basis.

A copy of the order was sent to the industry with the following letter:

To All Fertilizer Manufacturers:

Enclosed is a copy of Food Production Order 12, Revised. This supersedes the order as originally issued on May 1. Its primary purpose is to assure equitable distribution of the somewhat reduced supplies of organic nitrogenous materials in the approaching fertilizer year. Smaller supplies are anticipated because of the necessary diversion of oil seed meals for feeding purposes. In addition the Armed Services require large quantities as an aid in the grassing of airports and other military projects.

There is also enclosed Budget Bureau approved Form No. 40-4381 which must be executed by each manufacturer who wishes to procure organic nitrogenous materials, either for use as a component of mixed fertilizers or for sale as an ingredient in home mixtures. This form should be filled out and sent to us as quickly as possible, and in any event before July 1. After filing this form with us you are free to negotiate forward contracts, subject, however, to all pertinent provisions of the order.

It is the intent of this order to include under its provisions all nitrogenous materials, whether named within the text or not, except manures and humus. Your total

(Continued on page 26)

METHODS OF DIAGNOSING PLANT NUTRIENT NEEDS

(Continued from page 8)

and arraying all possible facts before any conclusions can be drawn. Since the supplies of nitrates, inorganic phosphates, and potash are the most frequently encountered critical factors, the diagnostician has gained much when the guessing about their adequacy is eliminated.

Plant Tissue Tests Prove Valuable in Fertility Research

Progress in fertility research is seriously handicapped as long as investigators are satisfied to ignore or guess at the nutritional status within the growing crop. It is a fallacy to argue that a technique exists that answers all the nutritional questions; yet when the tissue test method can indicate a "low" or "high" supply, or a state of balance of nitrate, or phosphate, or potash at an early stage of the plant growth, or throughout its growing period, it seems like common sense to consider such information valuable.

A typical "case history" is given in Table I to show how the tissue tests aid in studying old fertility experiments.

One of the permanent, general-fertility experiments maintained by the Purdue Experiment Station has been running continuously since 1919. This field at Huntington, Indiana, includes a comparison of various sources of phosphates for crop production. Inasmuch as these phosphate plots were laid out at a time when it was believed that the soil could supply adequate quantities of potassium for normal plant growth, potash was not included in the treatments.

The results of these tissue tests how that on the plots where various carriers of phosphates have been compared, potash has been the first limiting factor in the growth of corn. The yields of these plots have, therefore, been a function of the available potash instead of phosphorus, and the results obtained from the different phosphates are misleading. Plot 21, which had received some potash, was not receiving enough to supply the plants adequately.

As a result of these tissue tests, the potash deficiency has been corrected by adequate additions of KSl, so that in the future the yields will be a function of the phosphates used and a true comparison of the different forms of phosphates will be obtained.

In recent investigations at Purdue, much progress has been made in finding effective means of fertilizing corn directly on im-

TABLE II

CORRELATION OF PLANT TISSUE TESTS WITH RATES OF NITROGEN AND POTASSIUM FERTILIZATION. TREATMENTS AND YIELDS OF CORN. (DATA BY H. L. COOK, ON CROSBY SILT LOAM, LAFAYETTE, INDIANA, 1940.)

		Materials plowed under in lbs. per acre[1]		Yield Bu/A.	Increases above treatment No. 1[3]	Plant tissue test[4] July 10			Aug. 1		
No.		N[2]	K_2O			N	P	K	N	P	K
I	1	0	0	29.5		O	H	H	O	H	M
	2	21	0	36.3	6.8	M	H	M	O	H	L
	3	42	0	49.4	19.9	H	H	L	M	H	O
	4	84	0	52.8	23.3	H	H	O	H	H	O
II	11	0	50	30.8	1.3	O	H	H	O	H	H
	5	21	50	49.4	19.9	L	H	H	O	H	H
	7	42	50	56.2	26.1	H	H	H	O	H	M
	9	84	50	68.1	38.6	H	H	H	H	H	M
III	12	0	100	33.8	4.3	O	H	H	O	H	H
	6	21	100	50.1	20.6	L	H	H	O	H	H
	8	42	100	59.3	29.8	H	H	H	O	H	H
	10	84	100	71.8	42.3	H	H	H	M	H	H

[1] All plots received 300 lbs./acre of 0–16–4 at planting time.
[2] N was in form of cyanamid. Similar data are available with N in the form of ammonium sulfate.
[3] Significant difference 3.2 bus./acre.
[4] O, none; L, low; M, medium; H, high. Tests are an average of 6 plants from each of 5 replicates.

poverished soils. A typical case history that illustrates this is presented in Table II.

Attention is called to the following:

1. Phosphate was adequate in all plots; without the tissue tests, one would not be sure of this point.

2. In Group I, the tissue tests show that nitrogen was the first limiting element; but as the rate of application of nitrogen is increased, potassium becomes limiting. Without the tissue test, we might assume that the larger nitrogen treatments were not very effective.

3. In Group II, where 100 pounds of muriate of potash was plowed under with the nitrogen, it is apparent that nitrogen has become the limiting element except on the higher rates where the adequacy of potash had become doubtful by August 1.

4. In Group III, where 200 pounds of muriate were used, the potash test shows an adequate supply and the yields then become a function of the nitrogen application. Here it is interesting to note that nittrogen had become limiting by August 1, and that higher rates of application probably would have produced additional corn.

TABLE III

PLANT TISSUE TESTS AS AN AID IN STUDYING PHOSPHATE FERTILIZER PLACEMENT FOR CORN. (DATA BY A. J. OHLROGGE, ON CROSBY SILT LOAM, LAFAYETTE, INDIANA, 1940.)

Fertilizer Treatment, lbs. per acre		Plant Tissue Test			Yield
Plowed Under	Drilled in row	N	P	K	Bus.-A
120 lbs. N 120 lbs. K_2O	120 lbs. P_2O_5	VH	L	H	56.6
120 lbs. N 120 lbs. P_2O_5 120 lbs. K_2O		H	H	H	67.3

The point of view in the research represented by Table II was to find first, if possible, the boundaries of the nutritional factors necessary to produce an acceptable corn yield. In this approach, the costs of the treatments were not the deciding factors. The needs of the growing plant were the prime factors considered. To this end the plant tissue technique was used. Each season some limitations in the experiments were exposed by these tissue tests. This permitted corrections to be made for the next experiments. It was found that many assumptions, even old standard practices, were not measuring up to the requirements of the plants.

For example, during the 1940 season the plowing down of a phosphate fertilizer was compared with a similar application of phosphate in the row at planting time. In both cases the nitrogen and potash were plowed under. The season was characterized by a prolonged drought during July and August. Although the corn on the plowed-under fertilizer plot started slowly, it appeared more vigorous throughout the latter part of the growing season. Plant tissue tests were made on the corn plants the first week of August.

It was found on exposing a profile across the corn rows that very few active roots were in the very dry soil in which the row fertilizer was placed. On the other hand, there was an abundant growth of live roots in the moist soil at plow depth in which the plowed-under phosphate was placed. In this instance, the plant tissue test aided in diagnosing the role of fertilizer placement in plant nutrition. While the final yield showed that the phosphate placed in the row was not as effective as that plowed under, one would be inclined to assume that 120 lbs. of P_2O_4 per acre applied in the row would be more than enough phosphate for the corn. However, the tissue tests showed that the plants were not getting it from the dry soil.

More rapid progress was made in the experiments by defining the nutritional boundaries involved, and much time in the annual

See Page 4

replication of these experiments has been eliminated. With the optimum rate of nutrient supply and the method of placement accurately bounded, the next phase of the research was possible, i. e., to find the most economical way to meet these requirements for the crops grown under specific soil conditions. This is being done in experiments that have been conducted the past four years in which heavy applications of fertilizers have been used to obtain the lowest cost units of production.

FERTILIZING PEACHES FOR HIGH QUALITY FRUIT

(Continued from page 10)

eral nutrition of the tree. The earlier it is applied, the greater will be the effect this year. If a light application was made near bloom, a second application about the time the stones begin to harden is desirable, or, if not available at that time, apply it at any time up to the early part of the third growth period. While a general rule is to apply one-fourth pound of nitrate of soda or sulphate of ammonia per year of age of tree, with a maximum of five pounds per tree, some trees will not need this much. The grower must use his own judgment in adjusting the application to the vigor of the individual trees. This is especially important now when limited supplies are available. But most trees with a crop will make a satisfactory response to an application. *Remember that one bushel of good peaches will pay for the cost of fertili: er and its application to several trees.*

ORGANIC NITROGEN ORDER REVISED

(Continued from page 20)

purchases of organics permitted under the terms of this order for use in mixed goods or for sale as a component of home mixtures shall not exceed 70 per cent of the units of organic nitrogen used in the base period from July 1, 1941 to June 30, 1942.

You are not to include in this base, organic materials such as bone meal, tankage, cottonseed meal, Milorganite, Agrinite, etc., sold for direct application. Special authorization will be granted processors of these materials to sell some portion of their production for direct application. If it is found necessary to impose any restrictions on the sale of organic materials otherwise, it will be done in the War Food Administration general fertilizer order.

All organic materials sold for direct use will be considered specialty fertilizers and will be controlled at the processing point. Any offers of such materials made to you by processors for direct sale will be as a result of authorizations granted from this office and it will be required that they shall be sold as such. They are not otherwise subject to the provisions of this order.

Oil mills which also operate fertilizer plants should include in their base only the actual amount of seed meals and other organics actually used in mixed fertilizers, or sold by their fertilizer divisions as ingredients of home mixtures. Such mills who operate fertilizer plants should not include exchanges with farmers of seed for meal, the ultimate use of which by the farmer is unknown and therefore could not be considered as a legitimate part of a fertilizer manufacturer's base. All operators are requested to prepare their statements carefully since each will be subject to review and revision if not substantiated by bona fide records.

Let us cite a simple example of how a fertilizer manufacturer's base is to be established. Assume that a manufacturer used 7500 units of organic nitrogen in mixed fertilizer and sold 2500 units for home mixing in his base period. He also sold some 5000 units of organic nitrogen for direct application. This latter item should be ignored in computing the base. The actual base, then, would become the total of 7500 units for mixed goods and 2500 units for home mixing, totaling 10,000 units, 70 per cent of which would be 7000 units which he is eligible to acquire under the provisions of FPO 12.

It is not the purpose of this order to define the specific materials which may be acquired. Manufacturers may elect to acquire different materials than were used in the base period.

Accept our assurance that we shall do everything in our power to stimulate and expand the production of organic nitrogenous materials to meet all legitimate requirements. Our policy will be as flexible as the supply position warrants.

Very truly yours,
DAVID MEEKER, *Acting Chief,*
Chemicals and Fertilizers Division.

BUYERS' GUIDE • A CLASSIFIED INDEX TO ALL THE ADVERTISERS IN "THE AMERICAN FERTILIZER"

This list contains representative concerns in the Commercial Fertilizer Industry, Including fertilizer manufacturers, machinery and equipment manufacturers, dealers in and manufacturers of commercial fertilizer materials and supplies, brokers, chemists, etc.
For Alphabetical List of Advertisers, see page 33.

A Classified Index to Advertisers in "The American Fertilizer"

BUYERS' GUIDE

For an Alphabetical List of all the Advertisers, see page 33

BUCKETS—For Hoists, Cranes, etc., Clam Shell, Orange Peel, Drag Line, Special; Electrically Operated and Multi Power
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.

BURNERS—Sulphur
Chemical Construction Corp., New York City.

BURNERS—Oil
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.

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Hayward Company, The, New York City.

CARBONATE OF AMMONIA
American Agricultural Chemical Co., New York City.
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Link-Belt Company, Philadelphia, Chicago.
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Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
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CASTINGS—Iron and Steel
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
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CEMENT—Acid-Proof
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.

CHAIN DRIVES—Silent
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CHAINS AND SPROCKETS
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CHAMBERS—Acid
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.

CHEMICAL APPARATUS
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Duriron Co., Inc., The, Dayton, Ohio.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

CHEMICALS
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Division, The, Allied Chemical & Dye Corp., New York City.
Bradley & Baker, New York City.
DuPont de Nemours & Co., E. I., Wilmington, Del.
Huber & Company, New York City.

CHEMICALS—Continued
International Minerals & Chemical Corporation, Chicago, Ill
McIver & Son, Alex. M., Charleston, S. C.
Phosphate Mining Co., The, New York City.
Wellmann, William E., Baltimore, Md.

CHEMICAL PLANT CONSTRUCTION
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CHEMISTS AND ASSAYERS
Gascoyne & Co., Baltimore, Md.
Shuey & Company, Inc., Savannah, Ga.
Stillwell & Gladding, New York City.
Wiley & Company, Baltimore, Md.

CLUTCHES
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CONCENTRATORS—Sulphuric Acid
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.

CONDITIONERS AND FILLERS
American Limestone Co., Knoxville, Tenn.
Dickerson Co., The, Philadelphia, Pa.
Phosphate Mining Co., The, New York City.

CONTACT ACID PLANTS
Chemical Construction Corp., New York City.

COPPER SULPHATE
Tennessee Corporation, Atlanta, Ga.

COTTONSEED PRODUCTS
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

CRANES AND DERRICKS
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

CYANAMID
American Agricultural Chemical Co., New York City
American Cyanamid Co., New York City.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Jett, Joseph C., Norfolk, Va.
Wellmann, William E., Baltimore, Md.

DENS—Superphosphate
Chemical Construction Corp., New York City.
Stedman's Foundry and Mach. Works, Aurora, Ind.

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DISINTEGRATORS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

DRYERS—Direct Heat
Sackett & Sons Co., The A. J., Baltimore, Md.

DRIVES—Electric
Link-Belt Company, Philadelphia, Chicago.

DUMP CARS
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

DUST COLLECTING SYSTEMS
Sackett & Sons Co., The A. J., Baltimore, Md.

ELECTRIC MOTORS AND APPLIANCES
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

ELEVATORS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

ELEVATORS AND CONVEYORS—Portable
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

ENGINEERS—Chemical and Industrial
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

ENGINES—Steam
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

EXCAVATORS AND DREDGES—Drag Line and Cableway
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Link Belt Speeder Corp., Chicago, Ill., and Cedar Rapids, Iowa.

FERTILIZER MANUFACTURERS
American Agricultural Chemical Co., New York City.
American Cyanamid Company, New York City.
Armour Fertilizer Works, Atlanta, Ga.
Farmers Fertilizer Company, Columbus, Ohio.
International Minerals and Chemical Corporation, Chicago, Ill.
Phosphate Mining Co., The, New York City.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.

FISH SCRAP AND OIL
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Wellmann, William E., Baltimore, Md.

FOUNDERS AND MACHINISTS
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

GARBAGE TANKAGE
Wellmann, William E., Baltimore, Md.

GEARS—Machine Moulded and Cut
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

GEARS—Silent
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

GELATINE AND GLUE
American Agricultural Chemical Co., New York City.

GUANO
Baker & Bro., H. J., New York City.

HOISTS—Electric, Floor and Cage Operated, Portable
Hayward Company, The, New York City.

HOPPERS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

IMPORTERS, EXPORTERS
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Wellmann, William E., Baltimore, Md.

IRON SULPHATE
Tennessee Corporation, Atlanta, Ga.

INSECTICIDES
American Agricultural Chemical Co., New York City

LACING—Belt
Sackett & Sons Co., The A. J., Baltimore, Md.

LIMESTONE
American Agricultural Chemical Co., New York City.
American Limestone Co., Knoxville, Tenn.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
McIver & Son, Alex. M., Charleston, S. C.
Wellmann, William E., Baltimore, Md.

LOADERS—Car and Wagon, for Fertilizers
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Acid Making
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.
Duriron Co., Inc., The, Dayton, Ohio.
Fairlie, Andrew M., Atlanta, Ga.
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Coal and Ash Handling
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Elevating and Conveying
Atlanta Utility Works, East Point, Ga.
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Grinding and Pulverizing
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

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MACHINERY—Power Transmission
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Pumping
Atlanta Utility Works, East Point, Ga.
Duriron Co., Inc., The, Dayton, Ohio.

MACHINERY—Tankage and Fish Scrap
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MAGNETS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MANGANESE SULPHATE
McIver & Son, Alex. M., Charleston, S. C.
Tennessee Corporation, Atlanta, Ga.

MIXERS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

NITRATE OF SODA
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Division, The, Allied Chemical & Dye Corp., New York City.
Bradley & Baker, New York City.
Chilean Nitrate Sales Corp., New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

NITRATE OVENS AND APPARATUS
Chemical Construction Corp., New York City.

NITROGEN SOLUTIONS
Barrett Division, The, Allied Chemical & Dye Corp., New York City.

NITROGENOUS ORGANIC MATERIAL
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
DuPont de Nemours & Co., Wilmington, Del.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
McIver & Son, Alex. M., Charleston, S. C.
Smith-Rowland Co., Norfolk, Va.
Wellmann, William E., Baltimore, Md.

NOZZLES—Spray
Monarch Mfg. Works, Philadelphia, Pa.

PACKING—For Acid Towers
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.

PANS AND POTS
Stedman's Foundry and Mach. Works, Aurora, Ind.

PHOSPHATE MINING PLANTS
Chemical Construction Corp., New York City.

PHOSPHATE ROCK
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Phosphate Mining Co., The, New York City.
Ruhm, H. D., Mount Pleasant, Tenn.
Schmaltz, Jos. H., Chicago, Ill.
Southern Phosphate Corp., Baltimore, Md.
Virginia-Carolina Chemical Corp. (Mining Dept.), Richmond, Va.
Wellmann, William E., Baltimore, Md.

PIPE—Acid Resisting
Duriron Co., Inc., The, Dayton, Ohio.

PIPES—Chemical Stoneware
Chemical Construction Corp., New York City.

PIPES—Wooden
Stedman's Foundry and Mach. Works, Aurora, Ind.

PLANT CONSTRUCTION—Fertilizer and Acid
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

POTASH SALTS—Dealers and Brokers
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

POTASH SALTS—Manufacturers
American Potash and Chem. Corp., New York City.
Potash Co. of America, New York City.
International Minerals & Chemical Corp., Chicago, Ill.
United States Potash Co., New York City.

PULLEYS AND HANGERS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

PUMPS—Acid-Resisting
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Duriron Co., Inc., The, Dayton, Ohio.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

PYRITES—Brokers
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., New York City.
Wellmann, William E., Baltimore, Md.

QUARTZ
Charlotte Chem. Laboratories, Inc., Charlotte, N. C

RINGS—Sulphuric Acid Tower
Chemical Construction Corp., New York City.

ROUGH AMMONIATES
Bradley & Baker, New York City.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

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SCALES—Including Automatic Bagging
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SCRAPERS—Drag
Hayward Company, The, New York City.

SCREENS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SEPARATORS—Air
Sackett & Sons Co., The A. J., Baltimore, Md.

SEPARATORS—Including Vibrating
Sackett & Sons Co., The A. J., Baltimore, Md.

SEPARATORS—Magnetic
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SHAFTING
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SHOVELS—Power
Link-Belt Company, Philadelphia, Chicago.
Link-Belt Speeder Corporation, Chicago, Ill., and Cedar Rapids, Iowa.
Sackett & Sons Co., The A. J., Baltimore, Md.

SPRAYS—Acid Chambers
Monarch Mfg. Works, Inc., Philadelphia, Pa.

SPROCKET WHEELS (See Chains and Sprockets)

STACKS
Sackett & Sons Co., The A. J., Baltimore, Md.

SULPHATE OF AMMONIA
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Division, The, Allied Chemical & Dye Corp., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Hydrocarbon Products Co., New York City.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

SULPHUR
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Freeport Sulphur Co., New York City.
Texas Gulf Sulphur Co., New York City.

SULPHURIC ACID
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M. Charleston, S. C.

SULPHURIC ACID—Continued
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Wellmann, William E., Baltimore, Md.

SUPERPHOSPHATE
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.
Wellmann, William E., Baltimore, Md.

SUPERPHOSPHATE—Concentrated
Armour Fertilizer Works, Atlanta, Ga.
International Minerals & Chemical Corporation, Chicago, Ill
Phosphate Mining Co., The, New York City.
U. S. Phosphoric Products Division, Tennessee Corp., Tampa, Fla.

SYPHONS—For Acid
Monarch Mfg. Works, Inc., Philadelphia, Pa.

TALLOW AND GREASE
American Agricultural Chemical Co., New York City.

TANKAGE
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
International Minerals & Chemical Corporation, Chicago, Ill.
Jett, Joseph C., Norfolk, Va.
McIver & Son, Alex. M., Charleston, S. C.
Schmaltz, Jos. H., Chicago, Ill.
Smith-Rowland, Norfolk, Va.
Wellmann, William E., Baltimore, Md.

TANKAGE—Garbage
Huber & Company, New York City.

TANKS
Sackett & Sons, Co., The A. J., Baltimore, Md.

TILE—Acid-Proof
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.

TOWERS—Acid and Absorption
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.

UNLOADERS—Car and Boat
Hayward Company, The, New York City.
Sackett & Sons Co., The A. J., Baltimore, Md.

UREA
DuPont de Nemours & Co., E. I., Wilmington, Del.

UREA-AMMONIA LIQUOR
DuPont de Nemours & Co., E. I., Wilmington, Del.

VALVES—Acid-Resisting
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Duriron Co., Inc., The, Dayton, Ohio.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

WHEELBARROW (See Carts)

ZINC SULPHATE
Tennessee Corporation, Atlanta, Ga.

ALPHABETICAL LIST OF ADVERTISERS

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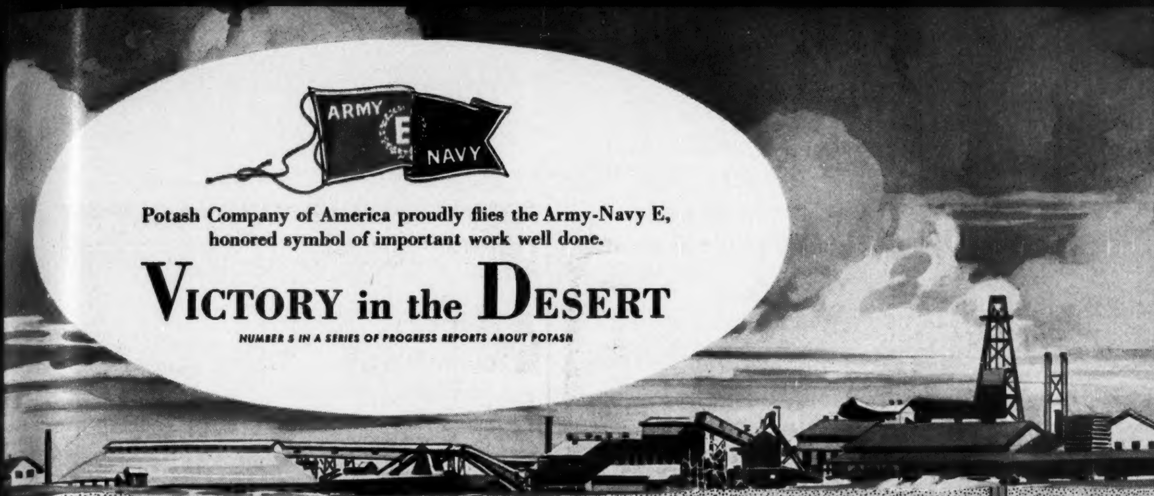


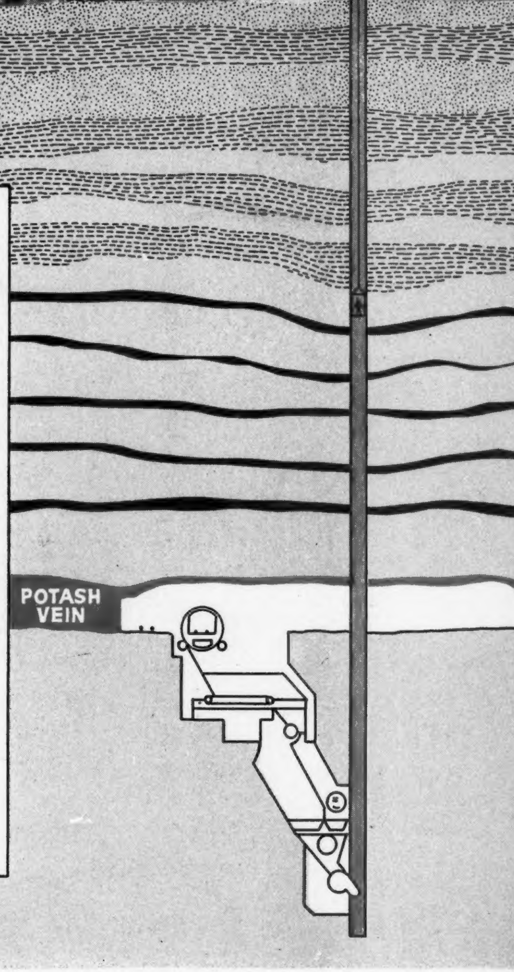
HITLER WILL REMEMBER THIS AMERICAN DESERT VICTORY, TOO

Have you ever stopped to think what might have happened if America had lost the Potash battle?

With the strength of our fighters, civilians and Allies depending on food, food and more food; with the chemical industry requirements constantly expanding, and with Allied needs for Potash as such, greater than ever, we need Potash now as never before.

As usual, America came through. Today, Potash is available—more than 1,000,000 tons of refined grades. Because of war's demands, agriculture is sharing it with industry and our Allies. Hitler won't forget this desert victory any sooner than he'll forget Tunisia.

Potash Company of America is proud of its part in this vital victory which has been won by American labor and capital deep under the desert sands of our own far West.



P.C.A. RED MURIATE

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GENERAL SALES OFFICE...50 Broadway, New York, N. Y. • SOUTHERN SALES OFFICE...Mortgage Guarantee Building, Atlanta, Ga.

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